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IC CARD AND MOBILE TERMINAL DEVICE
[IC kado oyobi keitai tanmatsu sochi]

Hiroataka Nishizawa, et al.

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INVENTORS	(72): NISHIZAWA, HIROTAKA; SHIRAISHI, ATSUSHI; YUGAWA, YOSUKE
APPLICANT	(71): HITACHI LTD, HITACHI VLSI SYSTEMS CO. LTD
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[Claim 1] (Access Status Display) An IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, and wherein the controller controls operation of the light-emitting elements so as to allow the status during memory access operations to be displayed.

[Claim 2] (Free Capacity Display) An IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, and wherein the controller controls operation of the light-emitting elements so as to allow the free capacity of the memory to be displayed.

[Claim 3] The IC card in Claim 2, wherein the controller is able to display the free capacity of the memory by emitting different colors from the light-emitting elements or activating or flashing different light-emitting elements.

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6

[Claim 4] (Command Response Display) An IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, and wherein the controller controls operation of the light-emitting elements in response to a given command inputted from the connector terminals.

[Claim 5] (Sector Control Data) The IC card in Claim 4, wherein the memory has a storage region for sector control data, and wherein the controller is able to read the required data from the storage region and output the data from the connector terminals at least during memory free space calculations.

[Claim 6] (Authorization Codes) The IC card in Claim 4, wherein the memory or the controller has a storage region for authorization codes, and wherein the controller is able to read authorization codes from the storage region and output the codes from the connector terminals.

[Claim 7] (Encryption Codes) The IC card in Claim 4, wherein the memory or the controller has a storage region for encryption codes, and wherein the controller is able to read encryption codes from the storage region and output the codes from the connector terminals.

[Claim 8] The IC card in any one of Claims 1 through 7, wherein the controller has a confidentiality protecting function for encoding data written to the memory and decoding data read from the memory.

[Claim 9] (Mobile Terminal Access Display) A mobile terminal device having an input unit, a data processing unit, a display unit and a card socket, wherein the data processing unit processes data in response to commands inputted from the input unit, controls the display on the display unit, and controls an IC card inserted into the card socket, and wherein the data processing unit is able to display on the display unit the status during an access operation performed on the memory inside the IC card inserted into the card socket.

[Claim 10] The mobile terminal device in Claim 9, wherein the display unit is a dot matrix display unit or an LED unit.

[Claim 11] (Mobile Terminal Free Capacity Display) A mobile terminal device having an input unit, a data processing unit, a display unit and a card socket, wherein the data processing unit processes data in response to commands inputted from the input unit, controls the display on the display unit, and controls an IC card inserted into the card socket, and wherein the data processing unit is able to read specific data from an IC card inserted in the card socket, and display on the display unit the free memory capacity based on the read data.

[Claim 12] The mobile terminal device in Claim 11, wherein the display unit is a dot matrix display unit, and wherein the free

memory capacity is displayed on the dot matrix display unit using certain icons or certain patterns.

[Claim 13] (Sector Control Data) The mobile terminal device in Claim 11, wherein the specific data contains sector control data on the file memory in the IC card inserted in the card socket.

[Claim 14] (Authorization) A mobile terminal device having an input unit, a data processing unit, a display unit and a card socket, wherein the data processing unit processes data in response to commands inputted from the input unit, controls the display on the display unit, and controls an IC card inserted into the card socket, and wherein the data processing unit is able to display the access or denial results for data read from specific data storage regions of the IC card inserted in the card socket.

[Claim 15] The mobile terminal device in Claim 14, wherein the specific data storage regions are divided into regions for authorization code storage and encryption code storage. /3

[Claim 16] (IrDA) An IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, and wherein the controller has an infrared transceiving module for controlling the transmission and reception of data.

[Claim 17] (Wireless) An IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, and wherein the controller has a wireless transceiving module for controlling the transmission and reception of data.

[Claim 18] (PD Enabled) An IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, wherein the controller has an antenna for transmission and reception of data and a wireless communication control circuit for wireless control of the antenna based on the data supplied from the controller, wherein the controller has a confidentiality protecting function for encoding data written to the memory and decoding data read from the memory, and wherein data read from specific data storage regions in response to commands from the connector terminals is supplied to the wireless communication control circuit.

[Claim 19] The mobile terminal device in Claim 18, wherein the specific data storage regions in the memory or controller are divided into regions for authorization code storage and encryption code storage.

[Detailed Description of the Invention]

[0001] [Industrial Field of Application]

The present invention relates to a technology for expanding the functionality of IC cards and improving the convenience of mobile data terminal devices using IC cards and, more specifically, to a technology for effective utilization of multimedia cards and replaceable memory cards.

[0002] [Prior Art]

Compact, lightweight memory cards with simple interfaces, such as multimedia cards have been introduced with the purpose of transferring data between mobile telephones and digital network devices. As described in "Interface" published by CQ Publishing Co., Ltd. (December 1999 Issue), these cards have seven connector terminals serving as external interface terminals and use a serial interface, which is a simpler system than the ATA interface used in PC cards and hard disks, and can lessen the burden on the host system. In the same publication, an SD card was introduced with a serial interface and nine connector terminals serving as a high-end replaceable memory card among multimedia cards.

[0003] [Problem to be Solved by the Invention]

The present inventors have studied storage IC cards such as multimedia cards. Storage IC cards such as PC cards using the PCMCIA (Personal Computer Memory Card International Association) standard were the first multimedia cards also to function as storage cards. At the present time, however, significant function expansion does not seem to be forthcoming. When contemplating use in mobile data terminal devices such as mobile telephones and personal digital assistants (PDAs), it became clear to the present inventors that user-friendly, expanded-function storage IC cards were needed by users of all ages and social strata.

[0004] A purpose of the present invention is to provide an IC card allowing access status and available capacity in installed memory to be easily displayed.

[0005] Another purpose of the present invention is to provide a user-friendly IC card able to protect the copyrights and privacy of all data stored in memory while allowing the data stored in memory to be transportable.

[0006] Yet another purpose of the present invention is to provide an IC card compatible with a multiplicity of interfaces.

[0007] Still another purpose of the present invention is to provide a storage IC card easier to use in a mobile terminal device.

[0008] Further description, additional purposes and novel characteristics of the present invention will become clearer after reading the specification and reviewing the appended drawings.

[0009] [Means of Solving the Problem]

The following is a simple summary of the invention disclosed in the present application.

/4

[0010] [1] The initial aspect of the present invention is the installation of a display function in the IC card itself. The first invention allows the status to be displayed during an access operation. In other words, the invention is an IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, and wherein the controller controls operation of the light-emitting elements so as to allow the status during memory access operations to be displayed. In this way, the status of an access operation performed on the internal memory can be displayed on the IC card itself. This can reduce incidents in which an access error occurs, the IC card is removed from the card socket, and data is destroyed.

[0011] The second invention allows the free memory capacity to be displayed. In other words, this invention is an IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor

integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, and wherein the controller controls operation of the light-emitting elements so as to allow the free capacity of the memory to be displayed. In this way, the free memory capacity can be identified on the IC card itself, a spare IC card can be prepared during a writing operation before the IC card runs out of memory.

[0012] The free capacity display mode uses light-emitting elements such as light-emitting diodes (LEDs). Here, the controller is able to display the free capacity of the memory by emitting different colors from the light-emitting elements or activating or flashing different light-emitting elements.

[0013] The third invention responds to external commands using the display on the IC card. In other words, the invention is an IC card having a substrate on which a semiconductor integrated circuit is mounted, and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, and wherein the controller controls operation of the light-emitting elements in response to a given command inputted from the connector terminals.

[0014] Because the light-emitting element display details are dictated by the external command, necessary data has to be outputted from the IC card when determining the internal state of the IC card or determining the display details based on the protected data inside the IC card. Here, for example, the memory has a storage region for sector control data to display the free capacity, and the controller is able to read the required data from the storage region and output the data from the connector terminals at least during memory free space calculations. The memory or the controller can also have a storage region for authorization codes for determining whether or not a user is authorized to use the data stored in memory, and the controller is able to read authorization codes from the storage region and output the codes from the connector terminals. In addition, the memory or the controller can have a storage region for encryption codes for determining whether a code is valid, and the controller is able to read encryption codes from the storage region and output the codes from the connector terminals.

[0015] If the data stored in the memory of the IC card is copyright protected, the controller can have a confidentiality protecting function for encoding data written to the memory and decoding data read from the memory.

[0016] The second aspect of the present invention is to make storage IC cards easier for mobile terminal devices to use. In the first invention of this aspect, the status during access of an IC card is displayed on the mobile terminal device. In other words, the

invention is a mobile terminal device having an input unit, a data processing unit, a display unit and a card socket, wherein the data processing unit processes data in response to commands inputted from the input unit, controls the display on the display unit, and controls an IC card inserted into the card socket, and wherein the data processing unit is able to display on the display unit the status during an access operation performed on the memory inside the IC card inserted into the card socket. Here, the display unit is a dot matrix display unit, a segmented liquid crystal display (LCD) unit or an LED unit.

[0017] In the second invention of this aspect, the free memory capacity in an IC card is displayed on the mobile terminal device. In other words, the invention is a mobile terminal device having an input unit, a data processing unit, a display unit and a card socket, wherein the data processing unit processes data in response to commands inputted from the input unit, controls the display on the display unit, and controls an IC card inserted into the card socket, and wherein the data processing unit is able to read specific data from an IC card inserted in the card socket, and display on the display unit the free memory capacity based on the read data. Here, the display unit is a dot matrix display unit, and the free memory capacity is displayed on the dot matrix display unit using certain icons or certain patterns.

[0018] When determining the display details based on the internal state of the IC card, the necessary data has to be outputted

from the IC card. When displaying the free memory capacity, the specific data contains sector control data on the file memory in the IC card inserted in the card socket.

/5

[0019] The third invention is a mobile terminal device for determining the display details based on the memory data in the IC card. In other words, this invention is a mobile terminal device having an input unit, a data processing unit, a display unit and a card socket, wherein the data processing unit processes data in response to commands inputted from the input unit, controls the display on the display unit, and controls an IC card inserted into the card socket, and wherein the data processing unit is able to display the access or denial results for data read from specific data storage regions of the IC card inserted in the card socket. Here, the specific data storage regions are divided into regions for authorization code storage and encryption code storage.

[0020] A third aspect of the present invention is the adaptability of the storage IC card to various interfaces. In other words, the invention is an IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, and wherein the

controller has an infrared transceiving module for controlling the transmission and reception of data.

[0021] In another example of an interface, the controller has a wireless transceiver interface module for controlling the transmission and reception of data.

[0022] In order to reduce transmission power, a wireless communication interface can also be used. In other words, the invention is an IC card having a substrate on which a semiconductor integrated circuit is mounted and a plurality of connector terminals is mounted, the connector terminals exposed from the casing, wherein the semiconductor integrated circuit contains a controller connected to the connector terminals and memory read-write enabled via the controller, wherein light-emitting elements are mounted so as to be exposed from the casing, wherein the controller has an antenna for transmission and reception of data and a wireless communication control circuit for wireless control of the antenna based on the data supplied from the controller, wherein the controller has a confidentiality protecting function for encoding data written to the memory and decoding data read from the memory, and wherein data read from specific data storage regions in response to commands from the connector terminals is supplied to the wireless communication control circuit. Here, the specific data storage regions in the memory or controller are divided into regions for authorization code storage and encryption code storage.

[0023] [Embodiment of the Invention]

< Memory Card With Display Function >

Figure 1 (A) shows the terminal side of a memory card, which is an example of the IC card of the present invention. Figure 1 (B) shows the chip-mounted side of the same memory card. The memory card [MC1] in the same figure is a memory card using the multimedia card standard with a display function added to the multimedia card. There are no actual limits on the present invention, but the size of memory card [MC1] conforms to the multimedia card standards with a thickness of 1.4 mm and plane dimensions of 24 mm x 32 mm.

[0024] The substrate [1] of the memory card [MC1] is a resin substrate such as a glass epoxy substrate. The terminal side contains seven equally spaced square connector terminals [2] with the same shape. Connection pads [3] with a one-to-one correspondence to the connector terminals [2] are formed on the mounted surface. The connection pads [3] consist of conductive patterns of aluminum, copper or iron alloy. The connector terminals [2] consist of conductive patterns of aluminum, copper or iron alloy plated with gold or nickel. The connections between the connection pads [3] and connector terminals [2] are established via conductive patterns on the card substrate [1] (simplified in the diagram) and through-holes on both sides of the card substrate [1].

[0025] The mounted surface of the card substrate [1] has, for example, read-and-writable flash memory [4], a controller chip [5], and an LED module [13]. The control chip [5] controls the read and

write operations performed on the flash memory [4] based on commands received from the outside via the connector terminals [2]. For the purpose of data security, the controller [5] has a confidentiality protecting function for encoding data written to the flash memory chip [4] and decoding data read from the flash memory chip [4]. The controller chip [5] also controls the display on the LED module [13]. The LED module [13] has two LED light-emitting elements, a red LED [13r] and a green LED [13g]. As shown in Fig. 22, the LEDs [13r, 13g] are exposed on the end of the casing [12] for the memory card [MC1]. When the memory card [MC1] is inserted into the card slot (simplified in the diagram), the LEDs [13r, 13g] turn on or flash to confirm insertion.

[0026] The controller chip [5] has a rectangular shape along the array of the connector terminals [2]. It has a plurality of connector interface terminals [5Pi] on the connector terminal [2] side connected to the connector terminals [2] via the connection pads [3], and has a plurality of memory interface terminals [5Pj] on the memory chip [4] side connected to the memory chip [4]. The memory chip [4] has a plurality of controller interface terminals [4Pk] on the controller chip [5] side connected to the controller chip [5]. The connector pads [3] are connected to the connector interface terminal [5Pi] on the control chip [5] via a pointing wire [7]. The memory interface terminal [5Pj] on the control chip [5] is connected to the controller interface terminal [4Pk] on the memory chip [4] via a pointing wire [8].

/6

[0027] The card substrate [1] has a test terminal [10] connected to the controller chip [5] and the memory chip [4] via a bonding wire (or conductive pattern) [11]. The card substrate [1] is attached to the casing [12] with the mounted side on the inside, the mounted side is protected by the casing [12], and the terminal side is exposed from the casing [12]. An example of connections made by the bonding wires [7, 8, 11] is shown in the figure. The terminals omitted from the figure are connected in similar fashion using bonding wires.

[0028] Here, the connector terminals [2] on the terminal side are numbered #1 through #7. In a multimedia card, #1 is the reserve terminal (open or set to binary number "1"), #2 is the command terminal (for inputting commands and outputting response signals), #3 and #6 are the ground voltage terminals for the circuit, #4 is the power voltage supply terminal, #5 is the clock input terminal, and #7 is the data input terminal. In serial peripheral interface (SPI) mode, #1 is the chip select terminal (negative logic), #2 is the data input terminal (for inputting data and commands from the host device to the card), #3 and #6 are the ground voltage terminals, #4 is the power voltage supply terminal, #5 is the clock input terminal, and #7 is the data output terminal (for outputting data and status from the memory card to the host device). The multimedia card mode is the ideal operating mode for systems simultaneously using a plurality of multimedia cards. Card identification ID (relative addresses) are used to identify the different multimedia cards sent inserted into the host device (not shown). The SPI mode is ideal for use in

simple, inexpensive systems. Here, multimedia cards are selected using chip selection signals supplied to the #1 connector terminal from the host device. In either operating mode, the controller chip [5] responds to commands sent from the host device by controlling access to the memory chip and controlling the interface with the host computer.

[0029] Figure 2 is a block diagram of the functions performed by memory card [MC1]. The controller chip [5] has an interface controller [50], an LCD driver [51], a flash memory controller [52], an encoding-decoding circuit [53], and a security circuit [54]. The interface controller [50] is connected to the host device (not shown) via a contact terminal [2], reads commands sent from the host device, and controls the entire memory card and controls the interface with the host device. The interface controller [50] contains a control program or mode transition control logic. There is no limit to the type of control used. The control program can also be located in the flash memory [4].

[0030] The interface control controls the interface in multimedia mode and SPI mode via a contact terminal [2]. Control of the entire memory card includes first authorization control for the security circuit, second encrypting-decrypting control for encrypting data written to the flash memory [5] and for decrypting data read from the flash memory, third controlling access to the file memory in the flash memory chip [4] via the flash memory controller [52], and fourth controlling display via the LCD driver [51].

[0031] Access control forms the basis of sector data control given that the file system can be replaced. Because data and files are controlled in 512-byte sector units, the memory array in the flash memory chip [4] is divided into 512-byte data areas corresponding to sectors, and control areas for each data area. The control areas contain data indicating whether the corresponding data area is storing active data for a sector, and pointing data pointing to the next sector. The control areas all consist of sector control tables [55]. In access control, the sector with the file targeted for access corresponds to a physical address in the flash memory chip [4], which can be read, erased, written and verified in different memory operations.

[0032] The encrypting-decrypting control consists of encrypting data to be written to the flash memory chip [4] using the encrypting-decrypting circuit [53] and writing the encrypted data to the flash memory chip [4], as well as decrypting the data read from the flash memory chip [4] using the encrypting-decrypting circuit [53], and outputting the decrypted data from the interface controller [50].

[0033] The following is an explanation of authorization control. If memory card [MC1] is used to distribute music data or text data, the data should be copyright protected. There is also need to protect the privacy of the contents of memory cards such as bank account data, insurance data, mobile telephone account data, and telephone numbers.

[0034] In copyright protection, an authorization code is presented by the host device and set in the authorization code control table [56] in the security circuit [54]; the music data corresponding to the authorization code is downloaded from the host device to the flash memory chip [4], and the write memory address is set in the authorization code control table [56] in the security circuit [54] corresponding to the authorization code. The /7 interface controller [50] when requested access from the host device determines whether the memory address of the file targeted for access is in the memory area corresponding to the authorization code in the authorization code control table [56] in the security circuit [54] using the authorization code control table [56]. When it corresponds to the authorization code, the security circuit [54] requests input of the authorization code from the interface controller [50]. If the inputted authorization code does not match the authorization code stored in the security code [54], access to the file is denied. The authorization code control table [56] can be electric read-writable non-volatile memory. The authorization code control table [56] can be in the interface controller [50] or the flash memory [4].

[0035] In the case of privacy protection, when a security code from the host device has been set in the security code control table [57] in the security circuit [54], the initialization of the memory card has been completed, and an initial read access request has been received for the flash memory chip [4], the security circuit [54] requests input of the security code from the interface controller

[50]. Until a security code that matches the security code set in the security code control table [57] has been entered from the outside, the interface controller [50] does not begin memory access control corresponding to the read request. The security code control table [57] can be electric read-writable non-volatile memory. The security code control table [57] can be in the interface controller [50] or the flash memory [4].

[0036] The display control includes the access status display process for the flash memory chip [4], the flash memory free capacity display process, and the authorization results display process for showing the results of authorization control.

[0037] Display control is not limited to these examples. Command input standby mode can be performed in response to an entered command. Standby mode can be realized initially after one or more memory cards [MC1] have been initialized.

[0038] The following is an explanation of the initialization process performed by the host device on the memory card with reference to Fig. 3. For example, the initialization process is started when power is supplied to one or more memory cards [MC1] (S1), the host device supplies clock signals on a specific cycle to the memory cards [MC1] to initialize the internal circuitry of the memory cards [MC1] (S2, and a memory card [MC1] is selected. In SPI mode, the host system selects a memory card [MC1] using chip selection signals. The selected memory card [MC1] outputs fixed card identification data containing the card ID register inside the

interface controller [50] to the host device (S4), and the host device reports the relative address of the memory card [MC1] corresponding to the fixed card identification data (S5). The relative address differentiates the memory card [MC1] from other memory cards and places it into standby mode (S6) or the command input standby mode. In multimedia mode, the memory card [MC1] is selected during initialization using a command. The selected memory card [MC1] is differentiated from the other memory cards using a relative address based on the fixed card identification data, and enters standby mode or command input standby mode.

[0039] Figure 4 is a flowchart of the access status display process performed by the interface controller [50]. When an access status request is received from the host device (S7) in standby mode (S6), the erase, write, read or verify operation being performed on the flash memory chip [4] is displayed by the interface controller [50] until the access request is complete (S8). The LCD driver [51] then operates the LED module in flashing mode (S9). Here, the flashing mode is the intermittent flashing of the green light. The process in S8 and S9 is repeated for every each access request from the host device (S10). The memory card then returns to standby mode (S6), and the process is repeated as long as the device is in standby mode.

[0040] Because the memory access operation status can be displayed, and the status of the access operation performed on the internal memory [4] can be displayed on the memory card [MC1] itself,

this can reduce incidents in which an access error occurs, the IC card is removed from the card socket, and data is destroyed.

[0041] Figure 5 is a flowchart of the flash memory chip free capacity display process controlled by the interface controller [50]. When a free capacity display command is received from the host device (S11) during standby mode (S6), the interface controller [50] reads the data indicating sector utilization from the sector control region in the flash memory chip [4] (S12), and calculates whether the free capacity in the data areas of the flash memory chip are in the 100-70% range, the 70-50% range, the 50-20% range, or the less than 20% range (S13). The interface controller [50] then sets the operational mode of the LCD module for the LCD driver [51] based on the results of the calculation (S14). For example, green LED [13g] turns on if the free capacity is 100-70%, the green LED [13g] flashes if the free capacity is 70-50%, the red LED [13r] flashes if the free capacity is 50-20%, and the red LED [13r] turns on if the free capacity is less than 20%. After operating the lights as required, the memory card [MC1] returns to standby mode (S6). /8

[0042] Because the interface controller [50] can control the operation of the LED module [13] to display the free capacity of the flash memory chip [4], and the free memory capacity can be displayed on the memory card [MC1] itself, a spare memory card can be prepared during a writing operation before the memory card runs out of memory.

[0043] Figure 6 is a flowchart of the authorization results display process controlled by the interface controller [50]. When

the security circuit [54] begins authorization control (S20), that is, when an authorization code for copyright protected data is inputted from the host device via the interface controller [50], or the security circuit [54] has the host device input the security code for privacy protected data, the security circuit [54] has the interface controller [50] operate the LED module [13] via the LED driver [51] (S21). The light operation can take any form, such as the red lights flashing in unison. The security circuit [54] determines whether the inputted authorization code or security code are valid, confirms the validity of the code (S22), stops the flashing of the LED module [13] (S23), and ends the authorization results display process.

[0044] As mentioned above, the results of authorization control can be confirmed via the memory card [MC1]. In other words, the user-friendly IC card is able to protect the copyrights and privacy of all data stored in memory while allowing the data stored in the memory of the IC card to be transportable.

[0045] Figure 7 shows the different operating modes for the LED module [13]. The operating modes shown in Fig. 7 (A), (B) and (C) operate the LEDs [13r, 13g] separately based on control signals [Sre, Sgr]. In Fig. 7 (D), the LEDs [13g, 13r] are connected in parallel with the anodes and cathode reversed. The power to the drive inverter for the LED drive circuit is +V and -V. Drive control signal [Sco] is common to both LEDs [13r, 13g]. In this operating mode, the LEDs [13r, 13g] cannot be turned on or flash completely in

parallel. However, if the frequency of the control signal [Sco] is as high as normal, red and green light can be mixed to form brown. If the control signal [Sco] switches intermediately at a set level and a high frequency, the light can flash intermittently between red and brown or green and brown. If Fig. (D) is used instead of Fig. 7 (A), (B) and (C), the light can flash intermittently between red and brown instead of flashing red and green in unison, or can flash intermittently between green and brown instead of flashing red and green in unison.

[0046] < Mobile Telephone Device >

The following is an explanation of a mobile terminal device equipped with a function allowing the memory card status to be displayed. Figure 8 is a block diagram of a mobile telephone device [100].

[0047] In the case of the audio, analog audio signals are received from the microphone [101], converted to digital audio signals by the analog-to-digital converter [102], and inputted to the data processor [103]. The data processor [103] performs audio encoding on the received digital audio signals, channel codec for layering, and outputs the processed signals as transmission signals. The audio encoding and channel codec can be performed using DSP or any other method. Although not shown in the figure, the data processor [103] contains an accelerator for channel codec and audio codec.

[0048] The transmission signals generated by the data processor [103] are modulated, for example, by a GMSK modulating circuit [104], converted to analog signals by a digital-to-analog converter [105], and transmitted from a high-frequency transmitter (RF transmitter) via an antenna [107].

[0049] Reception signals received by the antenna [107] are received by a high-frequency receiver (RF receiver) [108], converted to digital signals by an analog-to-digital converter [109], and retrieved by the data processor [103]. The data processor [103] performs viterbi decoding and audio decoding, and outputs the audio signals. The viterbi decoding and audio decoding are performed by a DSP or an accelerator (not shown).

[0050] The audio signals outputted from the data processor [103] are converted to analog audio signals by a digital-to-analog converter [110] and outputted as audio from the speaker [111].

[0051] The data processor [103] in the mobile telephone device [10] shown in Fig. 8 has a central processing unit (CPU) [112], a direct memory access controller (DMAC) [11], a read-only memory (ROM) [114] for storing the CPU [112] operating system, random-access memory (RAM) [115] for providing the CPU [112] work area, and an input-output circuit (I/O) [116] such as an input-output port and serial interface. This is not an exhaustive list, but the programs stored in the ROM [114] of the mobile telephone device [110] shown in Fig. 5 can be used by the data processor [103] to perform audio codec, channel codec for layering, and system control. The process

used to set the transmission control conditions for the DMAC [113] are performed by the CPU [112] using the operating system stored in the ROM [114].

[0052] The input switching unit [120], display controller [121] and card interface controller [122] (among other possibilities) can be connected to the I/O [116] of the data processor [103]. The input switching unit [120] has a plurality of input switches able to input numbers or text depending on the function indicated. The card interface controller [112] controls the interface between the memory card [MC2] inserted in the card socket [123] and the data processor [103]. Here, the memory card [MC2] does not have an LED module [13]. Another difference is that the interface controller [50] does not have a display control function, that is, control functions for performing the access status display process, the free capacity display process, and the authorization results display process. Display control is performed by the data processor [103] inside the mobile telephone device [100] using a display controller [121], a liquid crystal display [125], and an LED module [126]. In addition to the display control functions for access status, free capacity and authorization results, the data processor [103] in the mobile telephone device [100] has the appropriate display control functions for displaying telephone numbers to be called, calling telephone numbers, call status and battery voltage on the liquid crystal display [125] via the display controller [121]. In order for the data processor [103] to display the battery charge status on the LED

module [126] during operation, the red LED [126r] can be turned on to indicate insufficient charge and the green LED [126g] can be turned on to indicate sufficient charge. The operating format of the LED module [126] can have the same configuration as Fig. 7.

[0053] The following is an explanation of the control function for the access status display process, the free capacity display process and the authorization results display process performed by the data processor [103]. The object of the display control in these processes can be the LED module [126] described above. A liquid crystal display [125] can also be used.

[0054] The data processor [103] performs the access status display process in the following way. The data processor [103] causes the LED module [126] to flash when an access command has been issued to the memory card [MC2] until the memory card [MC2] has replied and the access process has ended. Here, the flashing can alternate between red and green.

[0055] In the free capacity display mode performed by the data processor [103], icons can be displayed on the liquid crystal display [125] as shown in Fig. 9 (A) through (C), or level indicators can be displayed as shown in Fig. 10 (A) through (C). When icons are displayed, the size of the black area relative to the overall size of the icons is a relative value, and a change in the relative size of the black area indicate a reduction in the free capacity. When level indicators are displayed, the number of black segments is a relative value, and a reduction in the number of black segments indicates a

reduction in the free capacity. The display mode for the free capacity display is the same for an LED.

[0056] Figure 11 is a flowchart of the free capacity display process for the flash memory chip inside a memory card [MC2] controlled by the data processor [103]. When the memory card [MC2] is in standby mode, the data processor [103] issues a free capacity data retrieval command to the memory chip [MC2] (S30). The interface controller inside the memory card [MC2] reads the sector utilization data from the sector control region of the flash memory and sends the data to the data processor [103]. The data processor [103] inputs the sector utilization data (S31), determines the free capacity in the data area of the flash memory based on this (S32), loads display data corresponding to the determined free capacity to the register of the display controller [121] (S33), and displays the free capacity on the liquid crystal display [125] based on the loaded display data (S34). In the case of an icon display, the icon data corresponding to the free capacity at the time is selected and displayed in a certain section of the liquid crystal display [125]. In the case of a level indicator display, the segments corresponding to the free capacity at the time are rendered black on the liquid crystal display [125]. The data processor [103] continues to issue free capacity data retrieval commands at set intervals when a memory card [MC2] is inserted in the card socket [123]. The most recent display data is maintained in the register between intervals, and the free capacity is displayed accordingly.

[0057] Figure 12 is a flowchart of the authorization results display process controlled by the data processor [103]. When the security circuit inside the memory card [MC2] begins authorization control, that is, when the data processor [103] supplies the authorization code for copyright protected data to the interface controller in the memory card [MC2] or the data processor [103] supplies the encryption code for privacy protected data to the security circuit via the interface controller in the memory card [MC2] (S35), the data processor [103] displays "Authorizing" on the liquid crystal display [125] via the display controller [121] (S36). The security code then determines whether the inputted authorization code or encryption code is valid. When the data processor [103] receives a valid result from the security circuit (S37), it displays "Authorization OK" in the liquid crystal display via the display /10 controller [121], and maintains the display for a set time interval (S38) before ending the authorization results display process.

[0058] In this way, the memory card [MC2] has access status display, free capacity display and authorization results display functions that are easier for a mobile telephone device [100] to use.

[0059] < Interface Versatility >

The following is an explanation of memory card with non-contact terminals in place of contact terminals.

[0060] Figure 13 (A) shows the terminal side of another memory card, and Fig. 13 (B) shows the chip-mounted side of the same memory card. The memory card [MC3] in these figures is a multimedia card

with an infrared interface function for high-end 8-bit data terminals. Another difference compared to the terminal side of memory card [MC1] is thirteen contact terminals [2] and connection pads [3]. Contact terminals #1 through #7 have the same layout as memory card [1] according to the multimedia card standard. The additional six contact terminals are #8 through #13. A flash memory chip [4], a controller chip [5A] and an infrared transceiver (IrDA) module [14] are mounted on the chip-mounted side of the card substrate [1A]. The IrDA module [14] consists of an infrared light-emitting diode [14tr] and an infrared photodiode [14rc].

[0061] Contact terminals [2] #1 through #7 constitute the first row of contact terminals on the card substrate [1A], and contact terminals [2] #6 through #13 constitute a separate second row of contact terminals. The size of contact terminals [2] #9 through #12 is the same as the other contact terminals [2]. The first row of contact terminals is arranged parallel to but a bit staggered from the second row of contact terminals. As for the space between contact terminals [2], the space between the terminals in the second row is a bit staggered compared to the space between the terminals in the first row. The contact terminals in the first and second rows form a somewhat zigzag shape.

[0062] Contact terminals #2 through #7 in memory card [MC3] are assigned the same functions as the same terminals in memory card [MC1] conforming to the memory card standard. In memory card mode, reserve terminal #1 is the 4th bit data terminal [DATA3], and extra

terminals #8, #9, #10, #11, #12 and #13 are 2nd bit data terminal [DATA3], 5th bit data terminal [DATA4], 7th bit data terminal [DATA6], 8th bit data terminal [DATA7], 6th bit data terminal [DATA5], and 2nd bit data terminal [DATA1], respectively. The 1st data terminal [DATA0] is terminal #7 in multimedia card mode. Therefore, memory card [MC3] differs from memory card [MC1] in a 8-bit parallel row data input-output is possible in the multimedia card mode of memory card [MC1].

[0063] Memory card [MC3] is also equipped with the lower-end modes of memory card [MC1] in multimedia card mode. In other words, the controller chip [5A] can perform parallel input-output in 1-bit mode using 1-bit #7 among the 8-bit data terminals #1 and #7-#13, four-bit mode using 4-bit #1, #7, #8 and #13 among the 8-bit data terminals #1 and #7-#13, or eight-bit mode using all 8-bit data terminals #1 and #7-#13.

[0064] The operational mode can be set in response to a specific contact mode or the contact input mode from specific contact terminals. For example, because memory card [MC3] has floating terminals #8-#13 when inserted in a card socket for a multimedia memory card [MC1], software or hardware (that is, a special hardware or software configuration) detects the floating state of one or both data terminals [DATA1, DATA2] allowing the controller chip [5A] to identify 4-bit mode when turned on. This sets the memory card [MC3] to 1-bit mode.

[0065] When memory card [MC3] is inserted into a special card socket, terminals #9-#13 are connected to card socket terminals. When turned on, the controller chip [5B] detects the supply of certain signals or commands from the host device to some or all of the data terminals [DATA4-DATA7], and sets the memory card [MC3] to 8-bit mode.

[0066] Controller chip [5A] differs from controller chip [5] in that it has eight data input-output terminals connected to connection pads [3]. Otherwise, it is identical to the configuration shown in FIG 1. For this reason, explanation of identical components with identical functions denoted by the same numbers has been omitted.

[0067] Figure 14 is a block diagram of memory card [MC3]. The controller chip [5A] has an interface controller [50A], an IrDA controller [51A], a flash memory controller [52], an encrypting-decrypting circuit [53], and a security circuit [54]. Interface controller [50A] is connected to the host device (not shown) via a terminal [2] to receive commands from the host device and control the interface between the entire memory card and the host device. The control of the entire memory card is the same as memory card [MC1] /11 with authorization control using a security circuit, encrypting-decrypting control for the flash memory chip [4], and access control for the file memory in the flash memory chip [4] via the flash memory controller [52]. The interface between the memory card and the host device is controlled using a control program or mode transition control logic (among other possibilities) in the interface controller

[50A]. The control program can also be housed in the flash memory chip [4].

[0068] The interface control is multimedia card mode or SPI mode interface control via the same terminals [2] as memory card [1], and infrared interface control using the IrDA module [14]. The program used by the IrDA controller [51A] to perform infrared interface control is stored in the flash memory chip [4] or the interface controller [50A]. The infrared interface control is based on the well-known 2.4-115.2 Kbps low to mid-speed communication standards of the Infrared Data Association. This uses the return-to-zero (RZ) method, and pulse width can vary from 1.6 μ sec to 3/16 bit time.

[0069] The memory card [MC3] is inserted in the card slot of a mobile telephone device such as the one shown in Fig. 15. The communication control conditions are set and the communication operation indicated by the IrDA controller [51A] based on commands sent from the data processor [103] via the interface controller [50A].

[0070] The memory card [MC3] inserted into the mobile telephone device [100] can then perform infrared communication with a personal computer [200] with an infrared communication function as shown in Fig. 16. This communication is not limited to the exchange of telephone numbers. When a mobile telephone modem circuit or mobile telephone modem card is installed in the personal computer [200], the mobile telephone device [100] can serve as a modem communication terminal, and data can be sent back and forth between the mobile

telephone device [100] and the personal computer [200] using infrared light.

[0071] IC cards containing an infrared communication function are not limited to storage IC cards such as memory card [MC3]. For example, if a modem card with an infrared communication function is inserted into a mobile telephone device, data communication can be performed by a personal computer [200] using the portable telephone device [100] as the communication terminal without having to equip the personal computer [200] with a portable telephone compatible modem.

[0072] The memory card [MC3] or IC card can be adapted for use in a wireless local area network (LAN) using infrared light. Here, the communication protocol can be stored in the ROM for the IrDA controller [51A] or the interface controller [50A].

[0073] Figure 17 is a block diagram of a memory card [MC4] able to support another type of wireless LAN (electromagnetic waves). The memory card [MC4] has a wireless LAN interface module [16] and an antenna [17] on the card substrate in addition to a ferroelectric memory chip FRAM (registered trademark) [4B] and a controller chip [5B]. The controller [5B] and the wireless LAN interface module [16] can be housed on a single chip.

[0074] The ferroelectric memory chip is a memory chip using a ferroelectric material such as lead zirconate titanate (PZT) in the memory element capacitors. The polarization phenomenon in the ferroelectric material is used to store data corresponding to binary

data (0, 1) securely. In other words, this memory is non-volatile RAM.

[0075] The wireless LAN interface module [16] transmits high-frequency signals from the antenna [17] via the interface controller [50B], detects high-frequency signals received by the antenna [17], amplifies and quantizes the detected signal components, and sends them to the interface controller [50B]. The interface controller [50B] sends data to be transmitted to the wireless LAN interface module [16] in accordance with wireless transmission/reception commands from the host device, and inputs and processes data received from the wireless LAN interface module [16]. The wireless LAN interface module [16] uses the input and output of encrypted data for authorization control and output authorization codes during access control.

[0076] The frequency bands used by wireless LANs such as radio LANs are 2.4 GHz and 19 GHz. Because the communication range of wireless LANs is narrower than the transmission area used by mobile telephone devices, the transmission power is lower and the communication costs are low because a mobile telephone network is not used. This means IC cards such as memory cards [MC4] equipped with a wireless LAN interface means inserted in mobile telephone devices [200A, 200B] can be used to exchange data at low cost and using very little power as shown in Fig. 18.

[0077] Here, an EEPROM controller or EEPROM chip can be used in place of the ferroelectric memory controller [52B] and the ferroelectric memory chip [4B].

[0078] Figure 19 and FIG 20 show an example of this antenna /12 [17]. In Fig. 19, the conductive pattern is formed only on the side of the one-layer wiring substrate with the terminals [2]. The antenna [17], in other words, consists of a conductive pattern formed on the terminal side. A wireless LAN interface module [16] is formed mounted side of the wiring substrate, and both ends of the antenna [17] are exposed on the mounted side via openings [17A] in the substrate and connected to the bonding pad on the wireless LAN interface module [16] via a bonding wire [17B]. In this figure, the ferroelectric memory [4B] has been omitted.

[0079] In Fig. 20, the conductive pattern is formed on both the mounted side and terminal side of a two-layer wiring substrate. The antenna [17] consists of a conductive pattern formed on the terminal side. A wireless LAN interface module [16] is formed mounted side of the wiring substrate, and both ends of the antenna [17] are connected to the wiring pattern [17D] on the mounted side via through-holes, and the end of the wiring pattern [17D] is connected to the bonding pad on the wireless LAN interface module [16] via a bonding wire [17B]. In this figure, the ferroelectric memory [4B] has been omitted.

[0080] Figure 21 is a block diagram of a memory card [MC5] using an antenna control circuit for reducing the amount of transmitting

power. The memory card [MC5] has a wireless communication control circuit [18] and an antenna [19] on the card substrate as well as a flash memory chip [4] and a controller chip [5C]. The controller chip [5C] and the wireless communication control circuit [18] can be on a single chip. The wireless communication control circuit [18] sends or receives carrier wave data in the appropriate format to and from the antenna [19] based on the data supplied from the interface controller [50C]. The specific data storage regions are tables [56, 57] and data areas in the flash memory [4] divided for storage of authorization codes or encryption codes.

[0081] For example, the antenna [19] can be a dipole antenna formed as a conductive pattern on the card substrate. It can be shaped so as to generate a half-wavelength current distribution from the wireless waves irradiated from an outside source. The wireless communication control circuit [18] has an on-off switchable transistor arranged between the poles of the antenna serving as the antenna controller. The antenna [19] is short-circuited when the switching transistor closes, and the impedance of the antenna [19] is set to a certain value when open. The switching control signals for the switching transistor are binary code (0 or 1) signals transmitted from the interface controller [50C]. Therefore, the final resistance for the dipole antenna [19] is 0 or a set value in response to the signals to be transmitted. When the radiation impedance and loaded impedance of the dipole antenna [19] are equal, the maximum reception power is obtained. If the loaded impedance is 0, the reception

voltage outputted to the antenna terminal is 0, the standing wave ratio of the current flowing to the antenna itself is increased, and the radiant power is increased. In other words, the dipole antenna [19] operates as a reflector. If signals at a set frequency are radiated to the dipole antenna [19] from the outside, the reflected waves are received by the outside unit. If the reflected waves change over time at the outside unit, the received signals modulated based on the impedance change in the dipole antenna [19] are, in a sense, signals transmitted from the impedance controller [50C]. Because a dipole antenna [19] does not require transmission power, the lower power consumption is possible.

[0082] The present invention devised by the present inventors has been explained in detail with reference to preferred embodiments. However, the present invention is by no means limited to these embodiments. Other variations are clearly possible within the scope of the invention.

[0083] For example, the IC card is not limited to memory cards or modem cards. The present invention can also be applied to a card combining the functions of a memory card and modem card. The memory chips are not limited to non-volatile memory. They can also be volatile RAM. The size of the card substrate, the number of connector terminals, and the functions of the connector terminals are not limited to those described in the explanation. These can be changed as desired. The wireless communication control also does not

have to be antenna control for converting to the interface properties of an antenna as described above.

[0084] [Effect of the Invention]

The following is a brief explanation of the effects obtained from the invention disclosed in this application.

[0085] The access status of memory mounted in an IC card and the free memory capacity of memory mounted in an IC card can be easily recognized.

[0086] The user-friendly IC card is able to protect the copyrights and privacy of all data stored in memory while allowing the data stored in the memory of the IC card to be transportable.

[0087] The IC card can be adapted to a wide variety of interfaces. The storage IC card is also easier to use in a mobile terminal device.

[Brief Explanation of the Drawings]

[FIGURE 1] A diagram used to explain the terminal side and chip-mounted side of a memory card that is a working example of the IC memory card of the present invention.

[FIGURE 2] A block diagram of the memory card function in the first working example.

[FIGURE 3] A flowchart of the initialization process for a memory card in a host device.

[FIGURE 4] A flowchart of the access status display process performed by the interface controller.

/13

[FIGURE 5] A flowchart of the flash memory chip free memory capacity process performed by the interface controller.

[FIGURE 6] A flowchart of the authorization results process performed by the interface controller.

[FIGURE 7] A diagram used to explain the operation of the LED module.

[FIGURE 8] A block diagram of a mobile telephone device in a working example of the present invention.

[FIGURE 9] A diagram used to explain the use of icons by the data processor for the free memory capacity display.

[FIGURE 10] A diagram used to explain the use of level indicators by the data processor for the free memory capacity display.

[FIGURE 11] A flowchart of the process performed by the data processor to indicate the free capacity of a flash memory chip inside the memory card.

[FIGURE 12] A flowchart of the process performed by the data processor to indicate authorization results.

[FIGURE 13] A diagram used to explain the terminal side and chip-mounting side of the memory card in the second working example of the present invention.

[FIGURE 14] A block diagram of the memory card functions in Fig. 13.

[FIGURE 15] A perspective view of the memory card in Fig. 13 inserted into the card slot on a mobile telephone device.

[FIGURE 16] A perspective view showing infrared communication performed between a memory card installed in a mobile telephone device and a personal computer.

[FIGURE 17] A block diagram of the memory card [MC4] in the third working example of the present invention supported by a wireless LAN.

[FIGURE 18] A perspective view of communication performed by a memory card [MC4] equipped with an interface means for a wireless LAN.

[FIGURE 19] A drawing used to explain an antenna formed by a conductive pattern on a one-layer wiring substrate of a memory card.

[FIGURE 20] A drawing used to explain an antenna formed by a conductive pattern on a two-layer wiring substrate of a memory card.

[FIGURE 21] A block diagram of the memory card in a fourth working example of the present invention using an antenna control circuit for reducing the amount of transmitting power.

[FIGURE 22] A perspective view of the LEDs exposed on the end of the memory card.

[Key to the Drawings]

MC ... memory card

1 ... card substrate

2 ... connector terminal

5 ... controller chip

4 ... flash memory chip

13 ... LED module

50 ... interface controller
51 ... LED driver
52 ... flash memory controller
53 ... encoding-decoding circuit
54 ... security circuit
55 ... sector control table
56 ... authorization code control table
57 ... encoding code control table
MC2 ... memory card
103 ... data processor
121 ... display controller
122 ... card interface controller
123 ... card socket
125 ... liquid crystal display
126 ... LED module
MC3 ... memory card
14 ... IrDA controller
5A ... controller chip
50A ... interface controller
51A ... IrDA controller
MC4 ... memory card
4B ... ferroelectric memory chip
5B ... controller chip
16 ... radio LAN interface module
17 ... antenna

50B ... interface controller
52B ... ferroelectric memory chip
MC5 ... memory card
5C ... controller chip
18 ... wireless transmission control circuit
19 ... antenna
50C ... interface controller

Figure 9

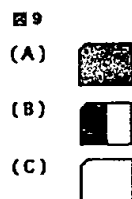


Figure 10

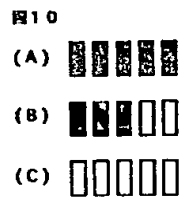


Figure 19

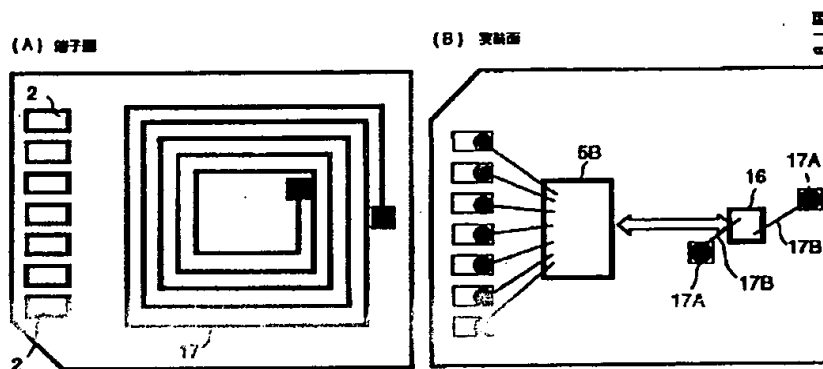
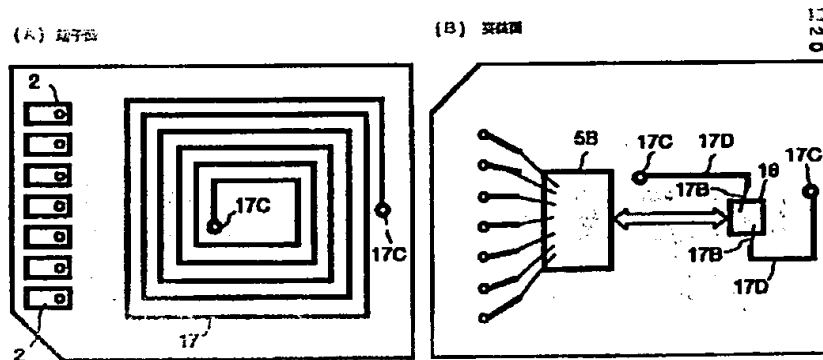


Figure 20



[FIGURE 19]

(A) Terminal Side

(B) Mounted Side

[FIGURE 20]

(A) Terminal Side

(B) Mounted Side

Figure 1

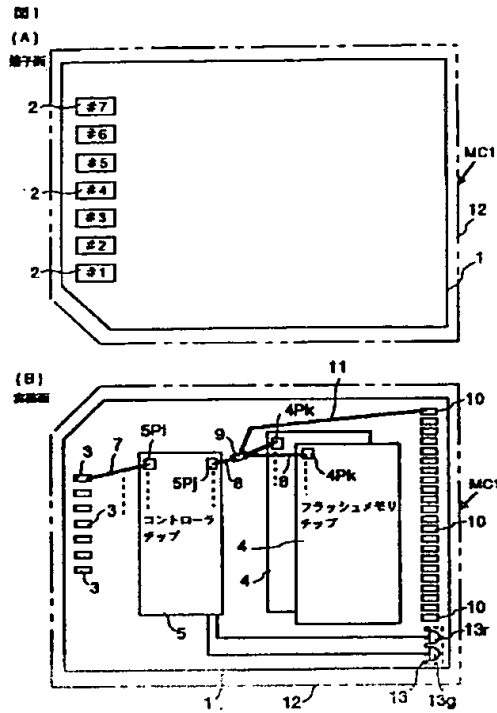


Figure 2

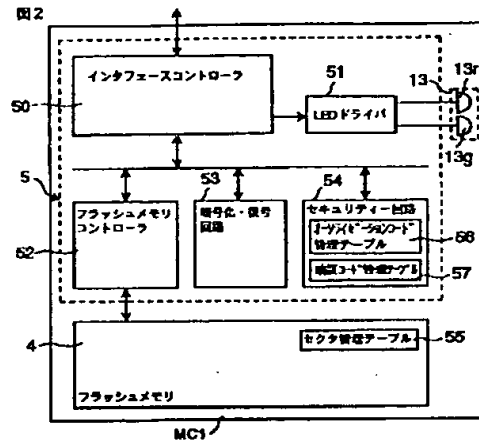
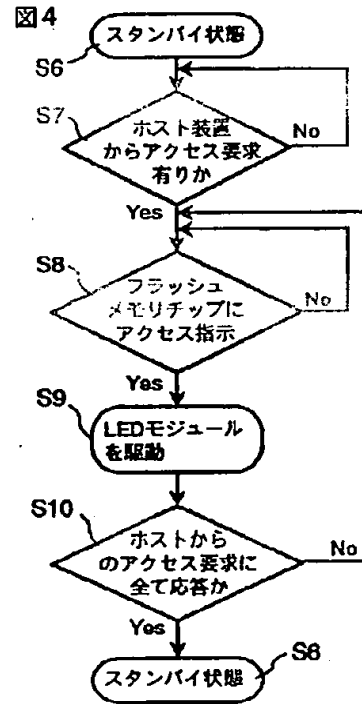
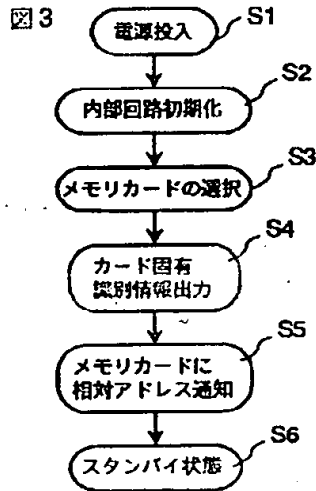


Figure 4

Figure 3



[FIGURE 1]

(A) Terminal Side

(B) Mounted Side

5 ... controller chip

4 ... flash memory chip

[FIGURE 2]

4 ... flash memory chip

50 ... interface controller

51 ... LED driver

52 ... flash memory controller

53 ... encoding-decoding circuit

54 ... security circuit

55 ... sector control table

56 ... authorization code control table

57 ... encoding code control table

[FIGURE 3]

S1 ... Turn on power

S2 ... Initialize internal circuits

S3 ... Select memory card

S4 ... Output fixed card identification data

S5 ... Notify relative address in memory card

S6 ... Standby mode

[FIGURE 4]

S6 ... Standby mode

S7 ... Access request from host device?

S8 ... Access to flash memory chip indicated?

S9 ... Operate LED module

S10 ... Response to all access requests from host device?

S6 ... Standby mode

Figure 5

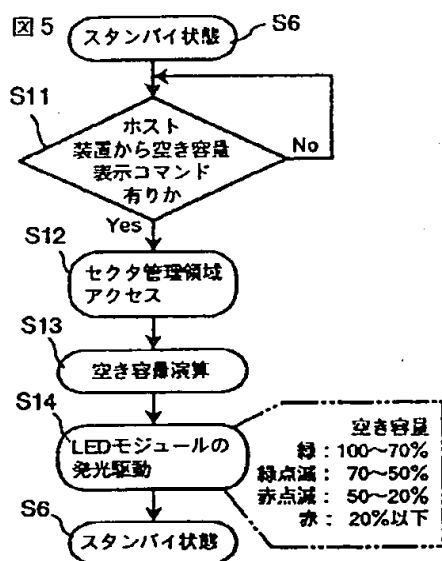


Figure 6

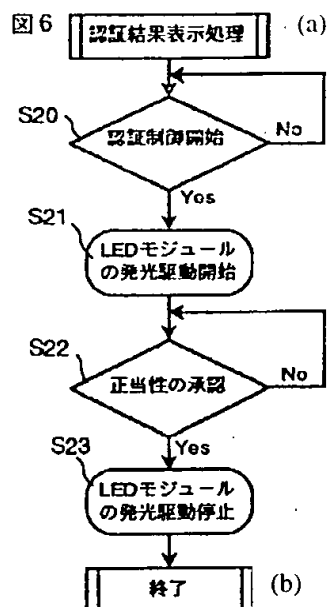


Figure 7

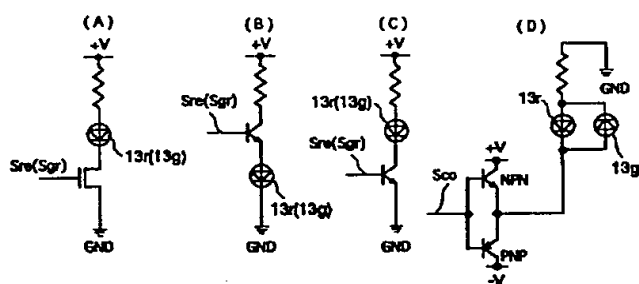


Figure 11

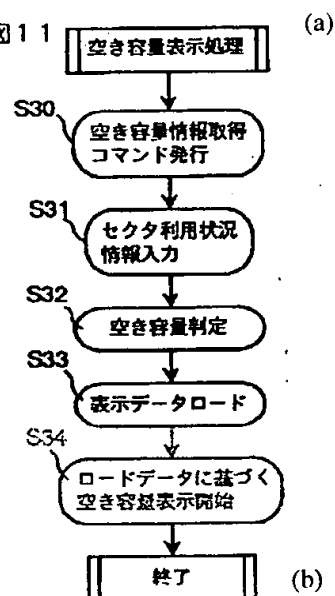
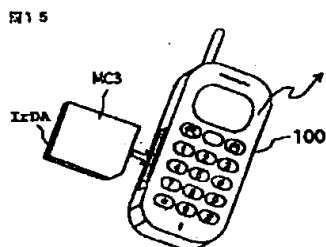


Figure 15



[FIGURE 5]

S6 ... Standby mode
S11 ... Any free capacity display command from host device?
S12 ... Access sector control region
S13 ... Calculate free capacity
S14 ... Activate LED module
Free Capacity
Green: 100-70%
Flashing Green: 70-50%
Flashing Red: 50-20%
Red: < 20%
S6 ... Standby mode

[FIGURE 6]

(a) Authorization Results Display Process
S20 ... Start authorization results
S21 ... Start operation of LED module
S22 ... Valid?
S23 ... Stop operation of LED module
(b) End

[FIGURE 11]

(a) Free Capacity Display Process
S30 ... Execute get free capacity data
S31 ... Enter sector utilization status data
S32 ... Determine free capacity
S33 ... Display data load
S34 ... Start free capacity display based on load data
(b) End

Figure 8

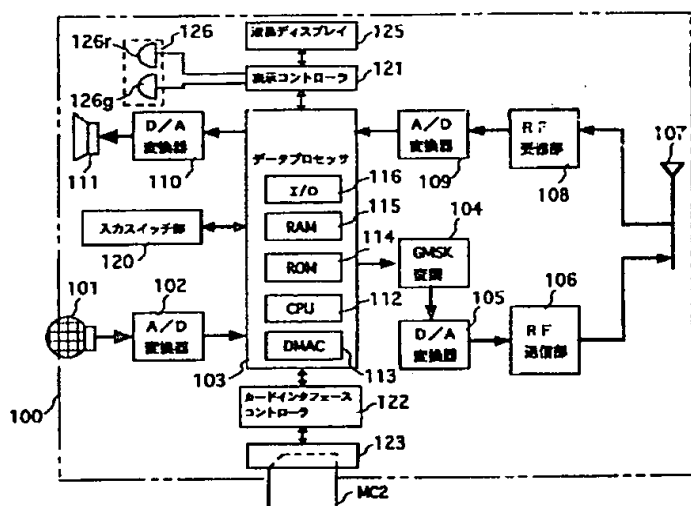


Figure 18

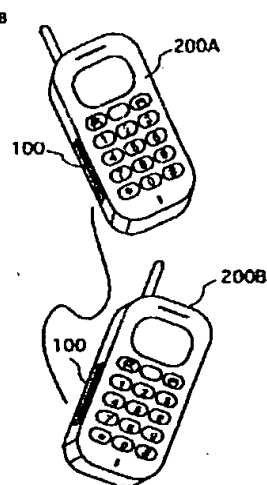


Figure 12

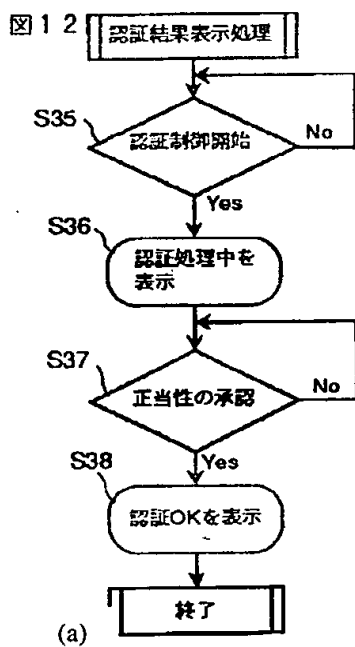
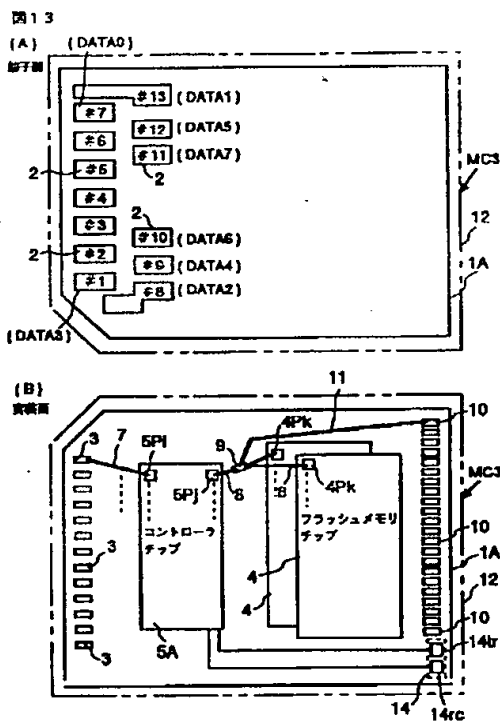


Figure 13



[FIGURE 8]

102 ... analog-to-digital converter
103 ... data processor
104 ... GMSK modulator
105 ... digital-to-analog converter
106 ... RF transmitter
108 ... RF receiver
109 ... analog-to-digital converter
110 ... digital-to-analog converter
120 ... input switch
121 ... display controller
122 ... card interface controller
125 ... liquid crystal display

[FIGURE 12]

Authorization results display process
S35 ... Start authorization control
236 ... Display "Authorization in Progress"
S37 ... Valid?
S38 ... Display "Authorization OK"
(a) End

[FIGURE 13]

(A) Terminal Side
(B) Mounted Side
4 ... flash memory chip
5A ... controller chip

Figure 14

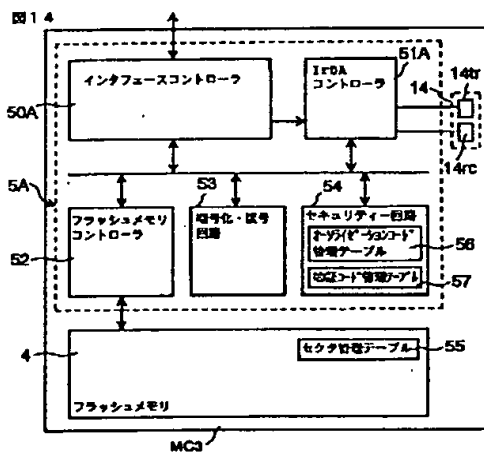


Figure 17

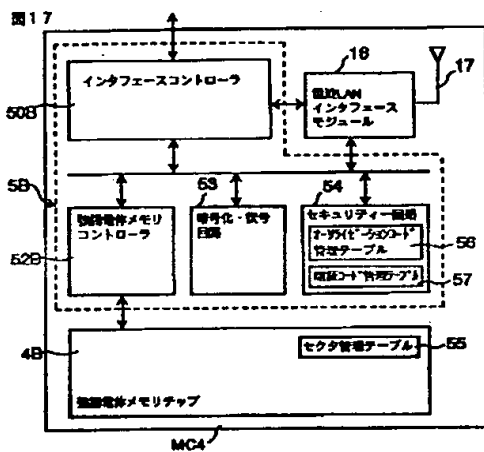


Figure 16

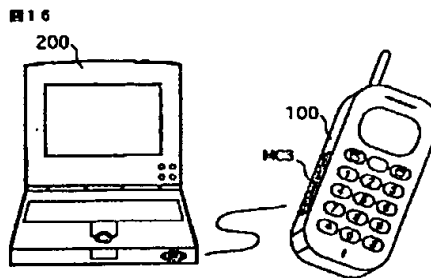


Figure 21

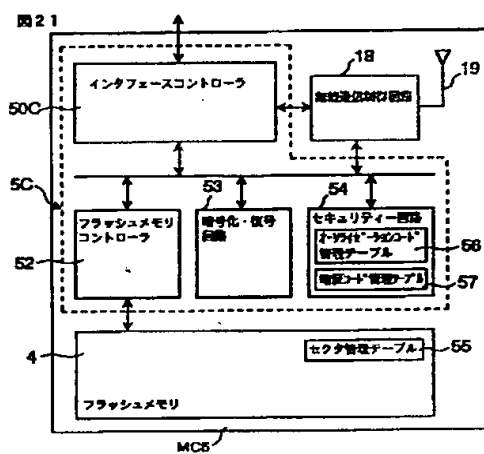
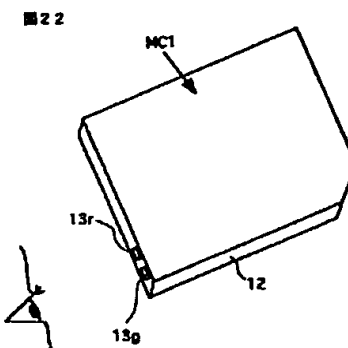


Figure 22



[FIGURE 14]

4 ... flash memory chip
50A ... interface controller
51A ... IrDA controller
52 ... flash memory controller
53 ... encoding-decoding circuit
54 ... security circuit
55 ... sector control table
56 ... authorization code control table
57 ... encoding code control table

[FIGURE 17]

4B ... ferroelectric memory chip
16 ... radio LAN interface module
50B ... interface controller
52B ... flash memory controller
53 ... encoding-decoding circuit
54 ... security circuit
55 ... sector control table
56 ... authorization code control table
57 ... encoding code control table

[FIGURE 21]

4 ... flash memory chip
18 ... wireless transmission control circuit
50C ... interface controller
52 ... flash memory controller
53 ... encoding-decoding circuit
54 ... security circuit
55 ... sector control table
56 ... authorization code control table
57 ... encoding code control table